World Academy of Science, Engineering and Technology
International Journal of Mathematical and Computational Sciences
Vol:14, No:12, 2020

Quasiperiodic Magnetic Chains as Spin Filters

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Abstract : A one-dimensional chain of magnetic atoms, representative of a quantum gas in an artificial quasi-periodic potential and modeled by the well-known Aubry-Andre function and its variants are studied in respect of its capability of working as a spin filter for arbitrary spins. The basic formulation is explained in terms of a perfectly periodic chain first, where it is shown that a definite correlation between the spin S of the incoming particles and the magnetic moment h of the substrate atoms can open up a gap in the energy spectrum. This is crucial for a spin filtering action. The simple one-dimensional chain is shown to be equivalent to a 2S+1 strand ladder network. This equivalence is exploited to work out the condition for the opening of gaps. The formulation is then applied for a one-dimensional chain with quasi-periodic variation in the site potentials, the magnetic moments and their orientations following an Aubry-Andre modulation and its variants. In addition, we show that a certain correlation between the system parameters can generate absolutely continuous bands in such systems populated by Bloch like extended wave functions only, signaling the possibility of a metal-insulator transition. This is a case of correlated disorder (a deterministic one), and the results provide a non-trivial variation to the famous Anderson localization problem. We have worked within a tight binding formalism and have presented explicit results for the spin half, spin one, three halves and spin five half particles incident on the magnetic chain to explain our scheme and the central results.

Keywords : Aubry-Andre model, correlated disorder, localization, spin filter
Conference Title : ICSRD 2020 : International Conference on Scientific Research and Development
Conference Location : Chicago, United States
Conference Dates : December 12-13, 2020